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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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10/056,154

01/23/2002

Vincent Fortin

M12524 US

2279

7590

09/24/2004

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EXAMINER

LEE, HSIEN MING

ART UNIT

PAPER NUMBER

2823

DATE MAILED: 09/24/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | |
|------------------------------|--------------------------------------|--------------------------------------|--|
| Office Action Summary | Application No. 10/056,154 | Applicant(s) FORTIN ET AL. | |
| | Examiner Hsien-Ming Lee | Art Unit 2823 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 June 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 23-60 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 27, 28, 30, 32, 33 and 36-44 is/are allowed.
- 6) ☒ Claim(s) 23-26 and 50-55 is/are rejected.
- 7) ☒ Claim(s) 29, 31, 34, 35, 45-49, 56-60 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.

- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

HSIEN-MING LEE
PRIMARY EXAMINER

Lee
9/21/2004

DETAILED ACTION

Remarks

1. Applicant's cancellation to claims 1-22 is acknowledged. Claims 23-60 are pending in the application.

Claim Objection

2. The limitation "... into the opening above material of the cobalt layer at the bottom of the opening" (claim 45, line 5 and claim 58, line 2) is objected to because of the ambiguity. Does it mean -- into the opening on the cobalt layer at the bottom of the opening -- ? Appropriate correction is required.

3. The term "largely of silicon " in claims 59 and 60 is a relative term which renders the claim indefinite. The forgoing term is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

4. In claim 46 (line 4) and claim 59 (line 5), changing "removing material of the silicon oxide" into – removing a portion of the silicon oxide – is suggested.

5. In claims 29 and 34 , at line 2, changing "comprised by" into – comprised of – is suggested.

6. In claim 31 (lines 2 and 5), claim 35 (lines 2 and 5), the term " the other of the source/drain regions" is unclear to the Examiner.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 23-26, 50-51 and 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of applicant's admitted prior art ("AAPA") and Choi (US 6,337,245).

In re claim 23, AAPA, in Figs. 1-2 and related text, teaches the claimed method for forming cobalt silicide on a body which has a surface that comprises silicon, the method comprising:

- forming a cobalt layer 120 over a body 100 which comprises silicon-containing gate;
- forming a titanium layer 130 over the cobalt layer 120 by ionized physical vapor deposition (i.e. sputtering);
- reacting cobalt of the cobalt layer 120 with silicon of a doped silicon section 100 of the gate to form a cobalt silicide layer 210; and
- substantially removing any un-reacted cobalt of the cobalt layer (col. 10, lines 4-6).

AAPA fails to teach that the cobalt layer is formed over an erasable programmable read-only memory region.

Choi, in Fig. 12 and related text, teaches the claimed method for forming cobalt silicide on a body which has a surface that comprises silicon, the method comprising:

- forming a cobalt layer (col. 9, lines 60-66) over a body 101' which comprises silicon-containing erasable programmable read-only memory region (i.e. a flash memory device having a structure of EPROM, col. 1, lines 24-27 and col. 3, lines 54-55);

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- reacting cobalt of the cobalt layer with silicon of a doped silicon section 101' of the erasable programmable read-only memory region to form a cobalt silicide layer 103; and
- substantially removing any un-reacted cobalt of the cobalt layer (col. 10, lines 4-6).

Therefore, one of the ordinary skill in the art, at the time of the invention was made, would have been motivated to apply the method of AAPA for forming the cobalt layer over the erasable programmable read-only memory region, as taught by Choi, for a reasonable expectation of success, since both AAPA and Choi forming a similar structure (i.e. forming a cobalt over a doped polysilicon region and reacting cobalt layer with polysilicon to form a cobalt silicide) and applying AAPA's method over the erasable programmable read-only memory region would not depart the spirit of the teachings of AAPA.

In re claims 24 and 26, AAPA in view of Choi also teach the claimed limitations because AAPA teaches forming a cobalt layer 120 over a body, which includes a first section comprising doped monocrystalline silicon 104 and a second section 100 situated on the first section 104, an opening (i.e. the region that expose the first section 104) extending through the second section down to the first section; and Choi remedies the deficiency of AAPA, as stated previously.

In re claim 25, Choi remedies the deficiency of AAPA when applying AAPA's method over the erasable programmable read-only memory region, as taught by Choi.

In re claims 50-51, the combination of AAPA and Choi also teaches the claimed limitation because AAPA teaches heating the body by rapid thermal annealing to reduce the resistivity of the cobalt silicide layer (paragraph [0003]).

In re claim 53, the selection of the thickness of the titanium layer is obvious because it is a matter of determining optimum process condition by routine experimentation with a limited number of species. In re Jones, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and In re Boesch, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious). For example, one of the ordinary skill in the art would have been motivated in selecting a desired thickness of titanium to sufficiently provide a protection function on oxygen attack during the subsequent processing step. In this case, applicant is required to demonstrate the criticality, generally by showing that the claimed thickness range would achieve unexpected results relative to the prior art range. See M.P.E.P. 2144.05 III

9. Claims 52, 54 and 55 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of AAPA and Choi as applied to claim 23 above, and further in view of Lee (US 2002/0001946).

In re claim 52, AAPA in view of Choi do not teach the claimed limitation. However, Lee teaches utilizing IPVD for forming a titanium layer over a body in a chamber at below-atmospheric pressure (i.e. a pressure of 1 to 100 m Torr; paragraph [0020]) without exposing the body to atmospheric pressure.

Therefore, one of the ordinary skill in the art, at the time of the invention was made, would have been motivated to perform the method of AAPA in view of Choi in below-atmospheric pressure, as taught by Lee, since by this manner it would prevent the resultant structure form external contamination.

In re claims 54 and 55, AAPA in view of Choi and Lee also teach the claimed limitations because the claimed limitation is the inherent characteristics of IPVD technique.

Allowable Subject Matter

10. Claims 27, 28, 30, 32-33 and 36-44 are allowed.
11. Claims 29, 31, 34, 35, 45, 46 and 58-60 would be allowable if rewritten or amended to overcome the objection, set forth in this Office action.
12. Claims 47-49 are objected to as being dependent upon an objected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.
13. Claims 56-57 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.
14. The following is a statement of reasons for the indication of allowable subject matter:

The prior art of record at least neither teaches nor suggests reacting cobalt with *silicon of the substrate* to form a cobalt silicide that contacts *remaining material of the substrate* (claim 27); forming a pn junction with each source/drain region, the floating gate extending *partially over* at least one of the source/drain regions (claims 28, 33); and forming a **select gate** overlying the substrate lateral to the floating gate (claim 32).

Response to Arguments

15. Applicant's arguments filed 6/21/2004 have been considered but are moot in view of the new ground(s) of rejection.

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16. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hsien-Ming Lee whose telephone number is 571-272-1863. The examiner can normally be reached on Tuesday-Thursday (8:00 ~ 6:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

HSIEN-MING LEE
PRIMARY EXAMINER

Hsien-Ming Lee
Primary Examiner
Art Unit 2823

9/21/2004

Sep. 21, 2004